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The Ultrasonic Evaluation of Nonfunctioning Thyroid Nodules

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Thyroid echography was carried out on 100 patients with thyroid abnormalities to evaluate the diagnostic accuracy of ultrasound in differentiating simple thyroid cysts from solid thyroid nodules.

In all 46 proven cases, the ultrasonic diagnosis of the solid or cystic nature of thyroid nodules was correct.

A proposed diagnostic workup of a hypofunctioning (cold) thyroid nodule is suggested with primary needle aspiration and cytologic examination of the cyst fluid being recommended if the nodule is shown to be entirely cystic by ultrasound.

SOLITARY HYPOFUNCTIONING THYROID NODULES have long posed a diagnostic dilemma for clinicians and surgeons. Several workers[1-6] have shown the efficacy of the noninvasive modality of ultrasound in the differentiation of the solid from the cystic nature of a solitary hypofunctioning thyroid nodule that is greater than 1.5 cm in diameter. This report summarizes our experience with solitary thyroid nodules and the role of ultrasound in patient management and treatment.

Methods and Materials

Thyroid echography was carried out at the Los Angeles County, University of Southern California Medical Center in 100 patients with thyroid abnormalities. Most of the patients were referred for ultrasonic evaluation of a solitary hypofunctioning thyroid nodule (cold nodule). Approximately 15 percent of the patients studied were referred from the internal medicine service for evaluation of solitary, clinically palpable thyroid nodules. The study was undertaken to determine the reliability of diagnostic ultrasound in distinguishing a simple cyst from all other nodules.

No patient preparation was necessary. The patients were studied with a commercially available ultrasonic scanner. All the patients were studied by means of two-dimensional or B-mode echography. A compound contact scanner with a nonfocussed 2.25 megahertz transducer was used in all patients. Each patient was studied in the recumbent position with the neck hyperextended by a pillow placed beneath the patient's shoulders and neck (Figure 1). Mineral oil was used as the coupling agent in all cases. The scans were done transversely across the neck at low, intermediate and high gain settings. The criteria used to diagnose cystic and solid lesions were the standard ones. Cysts were diagnosed on the basis of (1) persistent sonolucency with high gain settings, (2) a well-defined, smooth posterior wall and (3)

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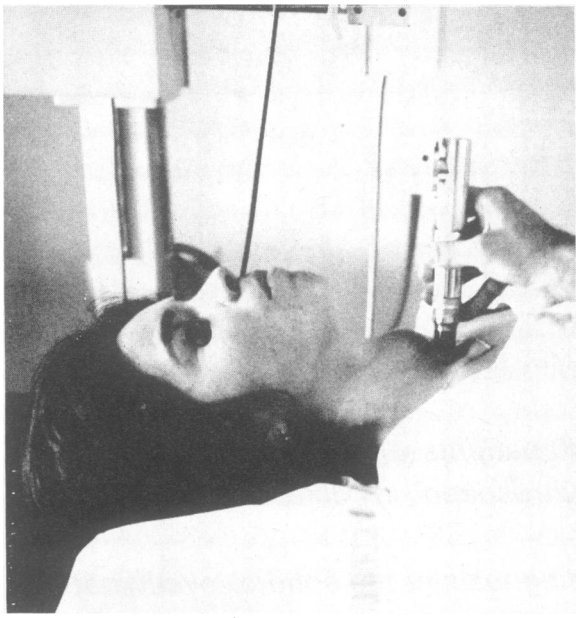

Figure 1.—A patient is shown being examined in the recumbent position with neck extended by a pillow beneath the shoulders and neck. An obvious thyroid nodule is easily seen.

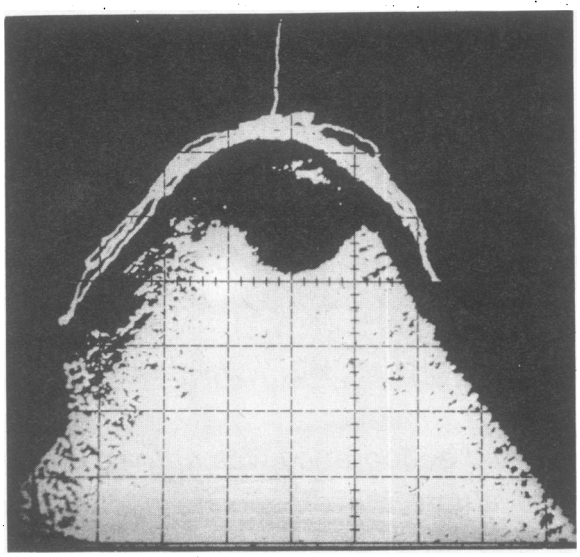

Figure 2.—(Case 1) A transverse scan of a typical cystic lesion is seen with a well-defined posterior wall, no echoes within the nodule and enhanced transmission through the lesion. The vertical line indicates the midline of the patient's neck. The grid lines are 1.5 cm per division. This nodule was surgically proven to be a colloid cyst.

enhanced transmission through the lesion (Figures 2, 3, 4). Solid lesions were diagnosed if (1) scattered or random internal echoes appeared within the lesion at intermediate to high gain settings, (2) a poorly defined posterior wall was present and (3) there was a lack of enhanced transmission through the lesion (Figures 5, 6). Multicystic lesions and solid lesions containing a cystic area were rejected in that percutaneous aspirations were to be carried out only on the simple cystic lesions. Adherence to these criteria is absolutely essential to the differentiation of solid versus cystic nodules. One exception was the simple cyst with an obvious internal septum.

The patients were instructed not to swallow or breathe deeply while the scan was being done. The position of head and neck was immobilized voluntarily. Great care was exercised to avoid distortion of the anatomy or movement of the thyroid nodule by applying excessive pressure to the skin with the transducer, or loss of acoustic contact with the skin. Both of these technical errors can cause artifactual echoes within a cystic lesion with resultant unnecessary thyroid cyst surgical operation. The procedure described is simple, safe and quick. The total length of the scanning procedure did not exceed five minutes in any patient and usually was two to three minutes.

Results

In 30 of the patients with solitary hypofunctioning nodules, there was pathologic proof. This consisted of either percutaneous needle aspiration of the cyst fluid or surgical pathologic proof. The fluid obtained by aspiration was routinely sent for cytologic examination. These 30 cases consisted of 7 cystic nodules (23 percent) and 23 solid thyroid nodules (77 percent). The group of 23 solid nodules was composed of colloid nodules (4 cases), adenomata (11 cases) and carcinoma (8 cases). In addition, three other preoperatively diagnosed cystic lesions were surgically proven to be thyroglossal duct cysts (Table 1).

There were 13 cases with clinically palpable thyroid nodules studied that, during subsequent studies, were determined to represent multinodular goiter with a single prominent nodule (12 cases) and Plummer's disease (1 case). These patients were referred to diagnostic ultrasound before radionuclide examinations were done. The remaining 54 patients are either on suppressive therapy, being evaluated for surgical procedures, or lost to follow-up.

It should also be mentioned that the clinical determination, by palpation, of the cystic or solid nature of a lesion is not reliable. There were numerous instances where the clinical impression was that of a cystic thyroid nodule and the lesion

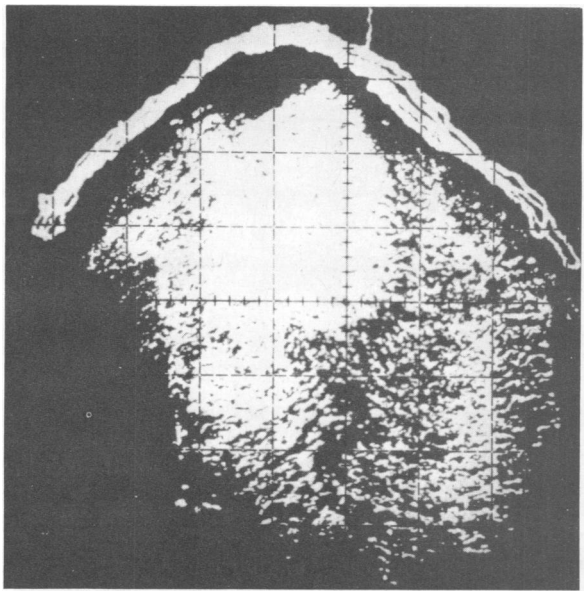

Figure 3.—(Case 2) A transverse scan showing a very superficial cystic lesion. The grid lines are 2 cm per division. This nodule was surgically proven to be a thyroglossal duct cyst.

was shown by ultrasound to be solid. There were also several instances where the clinical impression was that the nodule was solid and with echography it was shown to be cystic.

There were nine percutaneous aspirations on seven of the cystic thyroid lesions with one patient having three aspirations because of recurrence of the cyst. In two of the patients, surgical operations were carried out subsequently and the pathologic diagnoses in both of these cases were colloid cysts. As previously mentioned, three other ultrasonically diagnosed cysts proved to be thyroglossal duct cysts at subsequent surgical operation. All 10 proven cystic lesions, and all 23 proven solid lesions were correctly diagnosed. The prominent nodule in the multinodular glands and the nodule of Plummer's disease were also correctly diagnosed as being solid.

TABLE 1.—*Pathological Diagnoses in 33 Patients*

Pathological Diagnosis	*No. of Cases*	*Ultrasonic Diagnosis*		*Surgical Findings or Aspiration*	
		Solid	*Cystic*	*Solid*	*Cystic*
Colloid nodules	4	4	..	4	..
Adenomata	11	11	..	11	..
Carcinoma	8	8	..	8	..
Aspirated Cystic Nodules (with negative cytology)	7	..	7	..	7
Thyroglossal Duct Cysts	3	..	3	..	3
TOTAL	33	23	10	23	10

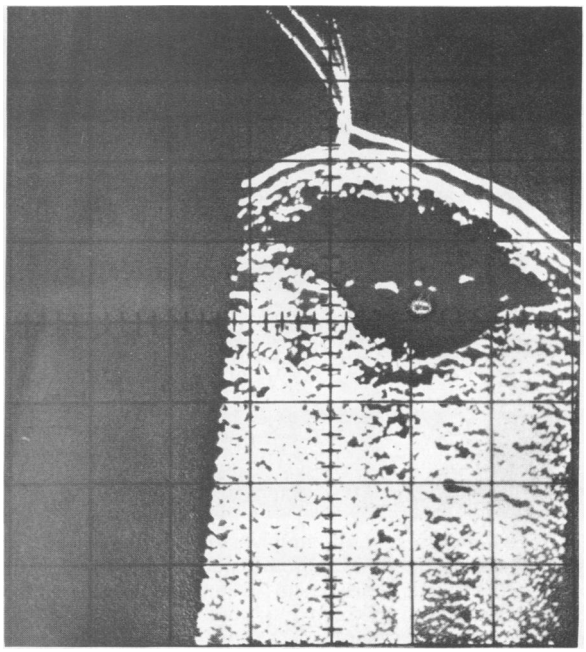

Figure 4.—(Case 3) A transverse scan over the patient's thyroid nodule. The lesion has the required cystic characteristics. The linear echo in the midportion of the nodule is typical for a septation. The grid lines are 2 cm per division. This nodule was proven to be cystic by aspiration.

Discussion

The introduction of isotopic scanning was a significant advance in the evaluation of a palpable thyroid nodule. This allowed differentiation of hyperfunctioning (hot) nodules from hypofunctioning (cold) nodules. This distinction is important because approximately 25 percent of all solitary nodules are hyperfunctioning[5] and the risk of malignancy in a hyperfunctioning nodule is extremely remote.

Solitary hypofunctioning (cold) thyroid nodules are composed of a heterogeneous group of lesions which includes both benign and malignant solid tumors, and benign thyroidal cysts. The reported frequency of malignancy in patients with hypofunctioning thyroid nodules varies depending upon their age; however, approximately 20 percent of patients with a nonfunctioning or cold thyroid nodule will have a malignant lesion,[7] and the incidence of solitary intrathyroidal cysts is approximately 20 percent of solitary hypofunctioning nodules.[5,8] The differentiation of the cystic or solid nature of a hypofunctioning thyroid nodule is of importance because of the far less risk of malignancy (approximately 1 to 2 percent) in solitary intrathyroidal cysts than in solid lesions.[5,8] The traditional management of a hypofunctioning

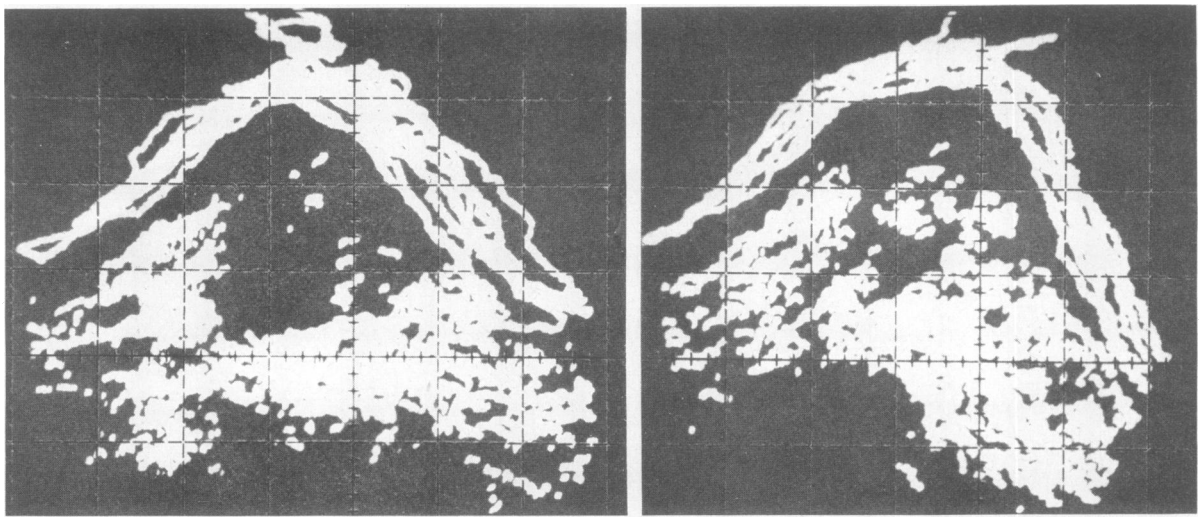

Figure 5.—(Case 4) Left, transverse scan, at a lower gain setting, showing characteristics of a solid nodule with internal echoes seen within the nodule. **Right,** transverse scan at a higher gain setting. More internal echoes can be identified, there is an irregular posterior wall and there is a lack of enhanced transmission through the lesion (compare with Case 1, Figure 2). The grid lines are 1.5 cm per division. This nodule was surgically proven to be a thyroid carcinoma.

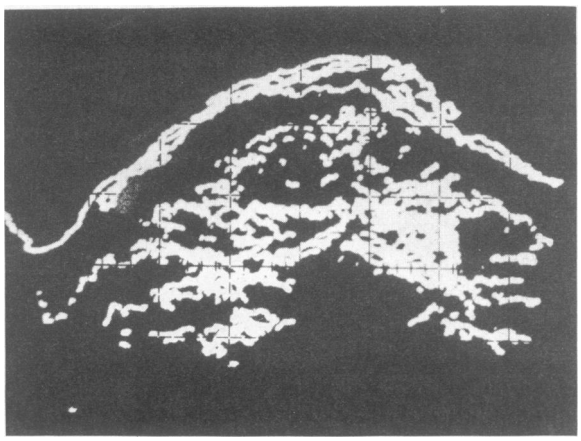

Figure 6. (Case 5). A transverse scan of a right-sided thyroid nodule. Even at this relatively low gain setting, internal echoes can be seen within the nodule. The grid lines are 1.5 cm per division. This nodule was surgically proven to be a thyroid adenoma. It should be noted that this nodule is ultrasonically the same as the previously shown thyroid carcinoma (Case 4, Figure 5). The differentiation by ultrasound between thyroid adenomas and thyroid neoplasms is not yet possible.

thyroid nodule noted on a radioisotope scan has been to consider the lesion malignant until proven otherwise (by surgical pathologic proof of the benign or malignant nature of the lesion). Now, with the advent of ultrasound as a noninvasive diagnostic tool, the cystic or solid nature of a hypofunctioning thyroid nodule can easily be determined.

Our experience, as well as the results of other investigators,[1-5] confirm the accuracy of ultrasound in identifying cystic thyroid nodules. Consequently, we feel that the most rational approach to the workup of a solitary palpable thyroid nodule greater than 1.5 cm in diameter would begin with a radioisotope scan. If the lesion is shown to be hypofunctioning, the patient should next be given an ultrasound examination. If the lesion is then shown to be cystic, the treatment should be conservative with primary needle aspiration and cytologic examination of the cyst fluid. This diagnostic workup will avoid the unnecessary expense and risk of thyroid surgical operation in a patient with a benign intrathyroidal cyst. Should the ultrasound examination show that the nodule is solid, then the usual course of workup and therapy may be pursued. In all cases, however, the addition of diagnostic ultrasound to the workup will allow a significant number of patients to be spared the risks of general surgical procedures.

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